1991 Summary Report: Location of Breeding Colonies and Evaluation of Critical Nesting Habitat for the Black Tern (*Chlidonias niger*) in Northwestern Minnesota: Kittson and Roseau Counties

Report to the Minnesota Department of Natural Resources

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INTRODUCTION

In recent years, a decline has been noted in the number of black terns (Chlidonias niger) over most of its range (Office of Migratory Bird Management 1987). Although the causes of this decline are not well understood, factors that have the potential to impact black terns are habitat loss, environmental contaminants, nest predation, competition for nest sites or food, adverse weather, and human disturbance (Carroll 1988; Hands et al. 1989).

Black terns were once listed as an abundant summer resident in Minnesota, breeding throughout the state (Roberts 1932). Currently, black terns are thought to breed throughout Minnesota, except for sections of the southeast and northeast (Janssen 1987). Breeding has not been confirmed recently in a number of counties, however (summarized in Hands et al. 1989), and the number of black terns is generally thought to be declining in Minnesota. Surveys are needed to document the number of breeding adults, locations of nesting sites and their characteristics, and reproductive success in order to determine the status of black terns in Minnesota and its requirements for protection. Information is particularly lacking for northwestern Minnesota, where intensive agriculture and the draining of wetlands have eliminated suitable habitat in an area where breeding has been documented.

The objectives of this study were to locate suitable habitat for black terns in Kittson and Roseau Counties in northwestern Minnesota, survey these areas, document evidence of breeding, and describe the habitat features and extent of black tern breeding colonies. This preliminary information will confirm the presence and magnitude of black terns breeding in these counties, and indicate potential conservation needs for these populations.

METHODS

Determination of survey sites:

The locations of potential black tern breeding sites in Kittson and Roseau Counties were determined by reviewing scientific literature, using reports of recent citings of black terns, and identifying areas from aerial photographs and topographic maps (scale 1:24,000). Potential areas for survey were considered to be those with a mixture of open water and emergent vegetation (Bent 1921) that were also accessible. Several sewage ponds were also censused early in the breeding season to indicate the presence of black terns in the area. Sewage ponds may be used as a feeding area but are not suitable for nesting.

Data collection:

Surveys were conducted 6-13 June 1991 to identify black tern breeding colonies and 16-21 July 1991 to document breeding success. Areas were surveyed from a vehicle, on foot, by canoe,

or from a boat. Data collected at each site surveyed were: a conservative, direct count of the number of adults and juveniles present (identified by plumage, Van Rossem 1923); activities of individuals (feeding, loafing, incubating, etc.); the presence of nests and chicks; wetland type (Cowardin et al. 1979), dominant vegetation, cover type (Stewart and Kantrud 1971) and degree of vegetation-water interspersion and edge shape (U.S. Army Corps of Engineers 1987). The approximate area of each site was calculated from aerial photographs (scale 1:24,000) and for breeding sites, the percent of the site that was occupied and the extent of the breeding colony were determined by visual estimation.

Sites were visited again in July if pre-breeding or breeding behavior was observed and potential nesting areas were present. Pre-breeding and breeding behavior included defense of nests, mobbing near nests, alarm calling, and incubation (Bent 1921, Goodwin 1960).

Nests were examined at two sites to provide information on the number of eggs per nest, water depth near nests, nest bowl and platform diameters, nest materials, presence of cover near nests, and distance between nests.

RESULTS AND DISCUSSION

Sites surveyed and presence of black terns:

A total of 17 sites in Kittson County and 10 sites in Roseau County were censused (Tables 1 and 2), including several State Wildlife Management Areas (WMA). Appendices 1 and 2 list the locations of all sites more precisely. A total of 26.8 h was spent on survey sites in Kittson County and 22.5 h on sites in Roseau County. The areas surveyed included nesting sites noted by Roberts (1932; Twin Lakes, Kittson County) and ten sites where black terns were noted before the start of this survey (K. Bardon, pers. comm.; J. Boe, pers. comm.). The remaining 10 sites in Kittson County and five sites in Roseau County were identified from aerial photographs and topographic maps; three of these sites were found to be plowed (Kittson: Red River valley, NE Orleans 2; Roseau: N. Juneberry Cemetary).

Black terns were observed at six sites in Kittson County and at seven sites in Roseau County (Tables 1 and 2). Several adults early in the season were still in their winter plumage and adults late in the breeding season were observed to be in early molt (white feathers around the head and neck). A sum of the minimum number of adults observed at each study site (using the largest count at each site) gives a total of 86 black terns for Kittson County and 515 for Roseau County.

All sites where black terns were observed in June were visited again in July (five sites in Kittson County and six sites in Roseau County) with the exception of Beaches WMA where only one tern and no suitable nesting habitat were seen in June.

Five sewage ponds in Kittson County and one sewage pond in Roseau Conty were also censused. In Kittson County, municipal

sewage ponds at Kennedy, Hallock, Lancaster, Lake Bronson, and Karlstad were visited on 6 June. Although terns had been seen in late May at the Lancaster, Lake Bronson, and Karlstad sewage ponds (K. Bardon, pers. comm.), on 6 June, black terns were observed feeding only at the Karlstad ponds (n=6 adults). In Roseau County, three black terns were observed feeding on 7 June at the Roseau municiple sewage ponds, where terns had been seen in late May (K. Bardon, pers. comm.).

Evidence of breeding:

Pre-breeding or breeding behavior (incubation, nest defense, or feeding young) was observed at Beeches Lake, Twistal Swamp, N. Twin Lake, and S. Twin Lake in Kittson County and at Roseau River WMA, Bednar dam, and Lake of the Woods (Springsteel-Barrier Islands, Warroad-SW marshes, and South shore) in Roseau County (Tables 1 and 2). However, only those sites where nests, chicks, or juveniles were observed were considered to be confirmed breeding colonies (Table 3). In Kittson County, these included Skull Lake, Beeches Lake, Twistal Swamp, and S. Twin Lake, and in Roseau County, Roseau River WMA, Lake of the Woods (Springsteel-Barrier Islands, Warroad-SW marshes, and South shore), and Bednar dam contained breeding colonies (total nine sites with colonies). There appeared to be at least nine separate breeding areas at Roseau River WMA, and one breeding area at each of the other eight sites.

Breeding behavior or evidence of breeding was not noted at several sites until July when chicks or juveniles were present (Skull Lake, Twistal Swamp, S. Twin Lake) or when sites were visited for the first time by boat (Springsteel-Barrier Islands, Warroad-SW marshes, and South shore). Although black terns at N. Twin Lake were defensive and gave alarm calls in some sections of the lake on 8 June, I did not observe evidence of breeding at this site on subsequent visits (11 June and 21 July). It is possible that nests were unsucessful, or that nests, chicks, or juveniles were present, but were located in inaccessible sections of the lake.

At least one chick or juvenile was seen at all breeding colonies except Bednar dam. At Bednar dam, four nests were being incubated on 10 June (10 adults present) but no terns were noted in the area on 16 July. It is possible that all nests failed and no renesting took place at this site, or that incubation was at an advanced stage on 10 June and all juveniles and adults had left the area by 16 July (fledging period= 20-25 days; Cuthbert 1954, Goodwin 1960, Bergman et al. 1970).

The first nest and eggs were found 9 June (Beeches Lake), and both chicks and juveniles were noted for the first time 16 July (Roseau River WMA). These dates do not reflect the earliest possible dates for nests, chicks, or juveniles, however, due to the gap in survey dates. The number of nests, chicks, and juveniles presented in Table 3 represent only those actually observed, and therefore only a small proportion of the actual number present at several sites. None of the sites was searched extensively in an attempt to count the exact number of nests, chicks, or juveniles present at at any given time, and a further

study with this objective would be required to document the reproductive success of these breeding colonies. In particular, breeding colonies at S. Twin Lake, Roseau River WMA, and Lake of the Woods were extensive, and their productivity is underestimated here.

Nest and nest site characteristics:

One nest was examined at Beeches Lake in Kittson County and 11 nests were examined at Roseau River WMA in Roseau County (Table 4). Ten nests were located during early June and two nests, possibly representing renesting attempts, were located 17 July. The number of eggs per nest varied from 0 to 3 eggs, with an overall mean of 2.0 eggs per nest. The mean number of eggs per nest was 2.4 for nests with at least one egg (n= 10 nests).

Nests were located on floating mats of dead vegetation or clumps of vegetation and mud, as noted for other black tern colonies (Cuthbert 1954, Goodwin 1960, Bergman et al. 1970, Dulin 1990). Cattails (Typha spp.), horsetails (Equisetum spp), and bullrushes (Scirpus spp) were sometimes used to create a built nest structure, while other nests consisted only of a slight depression in the substrate. Nest diameters ranged from 7.5 to 14 cm with a mean of 10.6 cm and platform diameters ranged from 25 cm to 2 m with a mean of 41 cm (Table 4). These values are similar to the mean diameter of 52 cm reported by Bergman et al. (1970) for floating mats of vegetation and cattail roots used as nest platforms by black terns.

Water depths near nests ranged from 28 to 132 cm, with the highest water levels present in July at Roseau River WMA (Table 4). These water depths are similar to those noted at black tern colonies in Saskatchewan (90 cm; Pittman 1927), Michigan (60 cm; Cuthbert 1954), New York (76 cm; Goodwin 1960), and southern Minnesota (means of 32-72 cm; Dulin 1990).

Nests were usually located in areas with at least some open water and a mix of cattail and horsetail or bullrush rather than in dense cattail stands, as noted for sites in southern Minnesota by Dulin (1990). Nests at Roseau River WMA were often placed in areas with bullrushes and horsetails that were within larger sections of cattails and open water patches, similar to nests found in areas with low and thin vegetation by Cuthbert (1954) in Michigan. The amount of cover near nests (within 0.3 m) varied from dense to absent, but in general, nests in sheltered areas (open water <5 m across) tended to have little cover nearby and nests in larger open water areas tended to have more cover near the nest. Bergman et al. (1970) noted this same trend for nests in Iowa. Most nests were spaced 3-8 m apart within breeding colonies, but spacing seemed to vary according to habitat suitability as noted by Bergman et al. (1970).

Habitat characteristics:

Survey sites included palustrine, lacustrine, and riverine wetland types (Cowardin et al. 1979), and breeding colonies were located in both palustrine and lacustrine areas in both counties (Tables 5 and 6). Several sites were impounded (Joe River WMA and Bednar dam), and water control structures are present at

Roseau River WMA and Skull Lake. Three areas had been excavated as gravel pits or to form ditches (NE Donaldson, Halma, Caribou); no black terns were seen at these sites. Nereson WMA (Roseau County) was created by the diking and flooding of a lowland woods, and now forms a scrub-shrub wetland with standing dead wood. Black terns were seen feeding in this area, but there were no indications that terns nested here.

Cattail stands and areas of mixed cattail and bullrush were the most common types of dominant vegetation on surveyed areas (Tables 5 and 6). Two other sites included horsetails as one of the dominant vegetation types, two included wild rice (Zizania spp), three sites included grasses (Phalaris spp), and three sites included mixed cattails and sedges (Carex spp). Dominant vegetation types at 8 of 9 breeding colonies included cattails, but only one site contained cattails as the only dominant plant. Six of 9 breeding colonies had a mixture of cattails and bullrushes, and one of these sites also included horsetails. One breeding area had a mixture of wild rice and bullrush, and the remaining colony was located in an area where cattail, horsetail, and wild rice dominated.

Cover types (Stewart and Kantrud 1971) of surveyed sites varied from areas almost entirely covered by vegetation to lakes or ponds with almost no emergent vegetation (Tables 5 and 6). Five sites had little open water (type 1), 13 sites had a mixture of open water and emergent vegetation (types 2 and 3), and six sites had very little emergent vegetation (type 4). Almost all black terns were seen at sites with cover types 2 or 3. Six breeding colonies were located in type 2 cover areas: five in areas of open water and scattered patches of emergent vegetation and one in an area with a central expanse of emergents surrounded by patches of open water (Twistal Swamp, Table 5). These areas fit the description of preferred habitat in Iowa wetlands (Weller and Spatcher 1965): areas of equal proportions of emergent vegetation and open water. Three breeding colonies were located in thick bands of emergents on the edges of larger open water areas (Tables 5 and 6).

Sites varied in the degree of interspersion of vegetation and water (Tables 5 and 6) from low, with continuous areas of water or vegetation, to high, with a mosaic of vegetation patches and water channels or pools (U.S. Army Corps of Engineers 1987). All nine sites surveyed that were classed as having a medium degree of vegetation-water interspersion had black terns, and seven of these sites included breeding colonies. Two of the three sites with high vegetation-water interspersion contained breeding colonies. Although 12 sites with a low degree of vegetation-water interspersion were surveyed, only one of these sites had black terns, and no breeding colony was found at this site. Dulin (1990) also found that black tern colonies in southern Minnesota were located in areas with intermittent open water rather than areas of dense cattails or large expanses of open water.

The shape of the boundary between the wetland and upland area (edge shape) was considered to be regular for 16 of the sites surveyed and regular for eight of the sites surveyed. Most

black terns were seen in areas with regular edges (8 of 12 sites), but breeding sites were located with almost equal frequency in areas with regular and irregular edges (5 and 4, respectively).

Extent of survey sites and breeding areas:

Areas that ranged in size from less than 0.5 ha to approximately 1500 ha were surveyed during this study (Tables 5 and 6). These approximate areas represent the portion of the area surveyed that might be used by black terns (both open water and emergent vegetation were present). The extensive dense cattail or sedge areas associated with Roseau River WMA, Caribou, and Juneberry Ridge, and the extensive open water areas of several Lake of the Woods sites (Elm Point-NW shore, South shore, and Warroad-SW marshes), were not included in these estimates of area.

During this survey, black terns were not seen in any areas smaller than 20 ha, and breeding colonies were located in areas ranging from 20 to 1500 ha (mean 288 ha, s.d.=473). The area with 1500 ha (Roseau River WMA, Table 6) included at least nine breeding sites, however. The mean approximate area for sites that were not plowed and where no terns were observed was 118 ha (s.d.=195). In other areas, black terns have been observed to use smaller wetlands as well: 1.6 ha (4 acres; Goodwin 1960) and 1.4 ha (Dorr 1976). Brown and Dinsmore (1986) found, however, that although wetlands >4 ha were used, wetlands >20 ha were used most frequently (Brown and Dinsmore 1986).

The actual proportion of breeding areas that appeared to be used by black terns varied from approximately 10-50%, with the following values: Skull Lake, 20%; Beeches Lake, 25%; Twistal Swamp, 10%; S. Twin Lake, 40%; Roseau River WMA, 30%; Bednar dam, 30%; Springsteel-Barrier Islands, 50%; Warroad-SW marshes, 20%; South shore, 10%. At Twistal Swamp, Roseau River WMA, and Bednar dam, nests (with eggs or chicks) were spread over approximately 0.02 ha, 7 ha, and 0.04 ha, respectively. At Roseau River WMA, the nine breeding sites identified were spread over approximately 0.3-2.8 ha, with most sites spread over 0.3-0.6 ha.

SUMMARY AND MANAGEMENT RECOMMENDATIONS

Twenty-seven potential black tern breeding sites were surveyed in Kittson and Roseau Counties, and breeding sites were identified at nine of these sites (four in Kittson County and five in Roseau County). Roseau River WMA in Roseau County appeared to be the most important breeding colony in northwestern Minnesota, and appeared to have at least nine breeding groups. Each other site apppeared to have one breeding group present, and the largest group in Kittson County was located in S. Twin Lake. In Kittson County, a total of 86 adults, five chicks, and seven juveniles were observed, and in Roseau County, 515 adults, 15 chicks, and 18 juveniles were observed. These totals represent approximate minimum numbers of individuals present, as an effort

was not made to census all individuals or reproductive success. Breeding areas in the two counties were similar, except that in general, breeding areas for black terns in Kittson County were smaller than those in Roseau County. Breeding habitat has most likely been limited in these areas by the draining and plowing of wetlands, and the construction of an extensive network of drainage ditches.

Factors such as water depth, wetland area, cover type, vegetation-water interspersion, and availability of nesting substrate have all been cited as important determinants of black tern colony location (Pittman 1927, Weller and Spatcher 1965, Brown and Dinsmore 1986, Carroll 1988, Dulin 1990). In this survey, cover type and vegetation-water interspersion seemed to be the most important factors determining the presence of black terns and breeding colonies, and the location of nests within colonies appeared to be determined by water depth and dominant vegetation type. Nesting areas were characterized by patches of interspersed emergent vegetation and open water, either within a marsh or on the edge of a large open water area. Nests were located in areas where water depths allowed the presence of emergent vegetation and nest substrate, and where bullrushes and horsetails or young cattails formed lower, less dense sites. Breeding colonies were located in sites of varying area, wetland type, and edge shape within the cover types and degree of vegetation-water interspersion mentioned above, and therefore did not appear to have as great an influence. All three of these habitat features, however, may influence the likelihood that preferred cover types and vegetation-water interspersion develop.

In order to maintain and improve black tern habitat in Kittson and Roseau County, the regulation of water levels is a critical factor. For example, drained wetlands or those impacted by drought conditions, as seen in Kittson County in particular, are not likely to support black terns due to the increased growth of cattails or sedges that fill in the wetland. Deep water will not promote the growth of emergent vegetation for nest substrate, and very open areas are also more subject to wind and wave action that can be a major cause of nest failure (Bergman et al. 1970). Water level regulation during the breeding season (May-July) should allow the most favorable vegetation-water interspersion and emergent vegetation density to develop, as suggested by Carroll (1988) and Hands et al. (1989). This strategy is possible especially for those areas in Kittson County (Skull Lake) and Roseau County (Roseau River WMA) that contain control structures. Water levels near 12 nests ranged from 28-132 cm in this study, and more data are needed to determine the most favorable water level for regulated areas.

Areas that seemed suitable except for the lack of nest substrate might be improved by adding nest platforms (Kittson: Joe River WMA, N. Twin Lake; Roseau: Nereson WMA). Sites that were very open or that had a low level of vegetation-water interspersion may benefit from the introduction of emergent vegetation, although the success of these introductions may depend on water level regulation at some sites.

An additional factor that needs to be considered is the potential for negative human impact, such as increased wave action in recreational areas and the disturbance of incubating or brooding adults (Dorr 1976). In general, wetland areas are isolated and little-used in these sparsely-populated counties, and some wetlands that were not accessible during this survey may support additional black tern breeding colonies. The potential for negative impacts by human activities particularly needs to be assessed at N. and S. Twin Lake in Kittson County and Nereson WMA and Lake of the Woods sites in Roseau County before needs can be identified.

This study represents a preliminary survey of black tern habitat and breeding areas in Kittson and Roseau Counties. More information is needed before further recommendations can be made on how best to promote and conserve black tern populations in these areas. In particular, aerial surveys of inaccessible areas, an assessment of reproductive success, more detailed habitat measurements and mapping, examination of more nests, and aerial surveys to quantify the extent of colonies and areas used would be useful.

LITERATURE CITED

Bent, A.C. 1921. Life histories of North American gulls and terns. U.S. Natl. Mus. Bull. 113. 345pp.

Bergman, R.D., P.Swain, and M.W. Weller. 1970. A comparative study of nesting Forster's and black terns. Wilson Bull. 82:435-444.

Brown, M.L. and J.J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. J. Wildl. Manage. 50:392-397.

Carroll, J.R. 1988. Status and breeding ecology of the black tern (Chlidonias niger) in New York. N.Y. State Dept. Environ. Conserv. Rep., Delmar. 20pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish Wildl. Ser., Office Biol. Services. U.S. Govt. Printing Office, Washington, D.C. 131pp.

Cuthbert, N.L. 1954. A nesting study of the black tern in Michigan. Auk 71:36-63.

Dorr, D.K. 1976. Black tern (Chlidonias niger) nesting habitat in Maine and its relevancy to the critical areas program. Planning Rept. 18, Critical Areas Program, Maine State Planning Office, Augusta. 13pp.

Dulin, G.S. 1990. 1990 Summary report of the Forster's and black tern breeding survey of the Minnesota River Valley. Unpubl. Rept. to Minn. Valley Natl. Wildl. Refuge, St. Paul. 16pp.

Goodwin, R.E. 1960. A study of the ethology of the black tern, Chlidonias niger surinamensis (Gmelin). Ph.D. Thesis, Cornell Univ., Ithaca, N.Y. 193pp.

Hands, H.M., R.D. Drobney, and M.R. Ryan. 1989. Status of the black tern in the Northcentral United States. U.S. Fish Wildl. Ser. Spec. Rept., St. Paul, Minnesota. 15pp.

Janssen, B. 1987. Birds in Minnesota. Univ. Minnesota Press, Minneapolis. 352pp.

Office of Migratory Bird Management. 1987. Migratory nongame birds of management concern in the United States: The 1987 list. U.S. Fish Wildl. Ser., Washington, D.C.

Pittman, H.H. 1927. The black terns of Saskatchewan. Condor 29:140-143.

Roberts, T.S. 1932. The Birds of Minnesota. Vol. 1. Univ. Minnesota Press, Minneapolis. 691pp.

Stewart, R.E. and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U.S. Fish Wildl. Ser. Res. Publ. 92, Washington, D.C. 57pp.

U.S. Army Corps of Engineers. 1987. Wetland Evaluation Technique. Vol. II. Methodology. U.S. Army Corps of Engineers and Environmental Lab, Washington, D.C.

Van Rossem, A.J. 1923. A study of some plumages of the black tern. Condor 25:208-213.

Weller, M.W. and C.S. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Agric. and Home Econ. Exp. Stn. Spec. Rep. 43. Iowa State Univ., Ames. 31pp.

Table 1. Presence and activities of Black Terns at sites surveyed in Kittson County in 1991.

Site	Date	Length of Survey (h)	Minimum # adults	Activities
Lake Stella	6 June	0.5	0	-
Red River valley	6 June	0.2	0	-
Joe River WMA	6 June	1	0	-
NE Orleans 1	6 June	0.3	0	-
NE Orleans 2	6 June	0.2	0	-
NE Donaldson	6 June	0.5	0	-
Skull Lake	6 June	1	5	in flight
	19 July	1	3	feeding
Lake Bronson	6 June	1	0	-
Halma	6 June	1	0	-
Karlstad	6 June	0.5	0	-
Caribou	19 July	0.5	0	-
Juneberry Ridge	9 June	0.5	0	-
Beeches Lake	9 June*	2	20	feeding, nest defense
	20 July*	1.5	6	feeding
Beaches WMA	9 June	0.5	1	feeding
Twistal Swamp	11 June	1.5	14	feeding
	19 July	1	10	feeding, nest defense, feeding young
N. Twin Lake	8 June*	2.5	20	feeding, nest defense
	11 June	0.5	20	feeding
	21 July	2	16	feeding
S. Twin Lake	7 June	0.5	12	feeding
	8 June*	1	26	feeding
	20 July*	1.5	12	feeding, nest defense, feeding young

* survey conducted from a canoe

Table 2. Presence and activities of Black Terns at sites surveyed in Roseau County in 1991.

Site	Date	Length of survey (h)	Minimum # adults	Activities
Roseau River WMA	7 June	2.5	358	feeding
	12 June*	5	340	feeding, incubating, nest defense
	16 July	5	162**	feeding, nest defense, feeding young
	17 July*	2.5	236**	feeding, nest defense, feeding young
Hanks Lake	7 June	0.5	0	-
N. Juneberry cemetery	13 June	0.3	-	-
Nereson WMA	7 June	1	12	feeding
	16 July	1	6	feeding
Bednar dam	10 June	1	10	feeding, incubating
	16 July	1	0	-
Lake of the Woods: Elm Point-NW shore	18 July*	1	6	feeding
Springsteel-Barrier Islands	7 June	0.5	20	feeding
	16 July	0.5	20	feeding, feeding young
	18 July*	1.5	75	feeding, feeding young
Warroad River	18 July*	0.5	0	-
Warroad-SW marshes	7 June	0.3	1	in flight
	16 July	0.5	25	feeding
	18 July*	1	46	feeding, feeding young
South shore	7 June	0.5	4	feeding
	16 July	0.5	8	feeding, feeding young

*area surveyed all or in part by canoe or boat
**number represents only a partial survey of the area

Table 3. Number of nests, chicks, juveniles, and adults observed at breeding colonies in Kittson and Roseau Counties.

Site	# adults*	# nests	# chicks	# juveniles
Kittson:				
Skull Lake	5	0	0	1
Beeches Lake	20	1	0	1
Twistal Swamp	14	0	3**	0
S. Twin Lake	26	0	2	5
TOTAL	65	1	5	7
Roseau:				
Roseau River WMA	358	15	9	1
Bednar dam	10	4	0	0
Lake of the Woods-Springsteel-Barrier Islands	75	0	6	14
Warroad-SW marshes	46	0	0	1
South shore	8	0	0	2
TOTAL	497	19	15	18

* largest number of adults counted at a site
** chicks were being fed at three nests, but I could not determine the exact number of chicks at each nest

Table 4. Data from nests examined at Beeches Lake and Roseau River Wildlife Management Area.

Site	Date	# nests examined	mean # eggs per nest	mean water depth in cm (range)	mean nest diameter (cm)	mean platform diameter (cm)
Beeches Lake	9 June	1	2	53	10	50
Roseau River WMA	12 June	9	2.4	55 (28-79)	11	64
	17 July	2	1.5	120 (102-132)	8	33
TOTAL		12	2	65 (28-132)	10.6	41

Table 5. Habitat characteristics of sites surveyed in Kittson County (*= breeding colony).

Site	Wetland type[a]	Dominant vegetation[b]	Cover type[c]	Approximate area (ha)[d]	Vegetation-water interspersion[d]	Edge shape
Lake Stella	palustrine	C	3	20	low	regular
Red River valley	(plowed)	-	-	17	-	-
Joe River WMA	palustrine-I	C,B	2	30	high	irregular
NE Orleans 1	palustrine	C,S	1	20	low	regular
NE Orleans 2	(plowed)	-	-	13	-	-
NE Donaldson	palustrine-E	C	4	<0.5	low	regular
*Skull Lake	palustrine-I	C,H,W	2	20	medium	irregular
Lake Bronson	lacustrine	G	4	260	low	irregular
Halma	palustrine-E	G	4	<0.5	low	regular
Karlstad	palustrine	C,S	1	120	low	regular
Caribou	palustrine-D	C	1	160	low	regular
Juneberry Ridge	palustrine	C,S	1	650	low	irregular
*Beeches Lake	palustrine	C,B	2	45	high	irregular
Beaches WMA	palustrine	C	1	1100	low	irregular
*Twistal Swamp	palustrine	C	2	450	medium	regular
N. Twin Lake	lacustrine	C,B	3	85	medium	regular
*S. Twin Lake	lacustrine	C,B	3	100	high	regular

a. I: impounded; E: excavated gravel pits; D: ditches
b. C: cattails (Typha spp); B: bullrushes (Scirpus spp); S: sedges (Carex spp); H: horsetails (Equisetum); W: wild rice (Zizania spp); G: grasses (Phalaris and others)
c. 1: open water covers less than 5 percent of the wetland; 2: open water covers 5 to 95% and emergents are located in scattered patches or in the central portion; 3: central expanses of open water surrounded by bands of emergents; 4: open water covers more than 95%
d. data from the portion of the wetland with at least some open water present

Table 6. Habitat characteristics of sites surveyed in Roseau County (*= breeding colony).

Site	Wetland type[a]	Dominant vegetation[b]	Cover type[c]	Approximate area (ha)[d]	Vegetation-water interspersion[d]	Edge shape
*Roseau River WMA	palustrine-I	C,B,H	2	1500	medium	irregular
Hanks Lake	palustrine	C,G	4	10	low	regular
N. Juneberry cemetery	(plowed)	-	-	40	-	-
Nereson WMA	lacustrine-I,S	C	3	150	medium	regular
*Bednar dam	palustrine-I	W,B	2	30	medium	regular
Lake of the Woods:						
Elm Point-NW shore	lacustrine	C	4	50	low	regular
*Springsteel-Barrier Islands	lacustrine	C,B	2	80	medium	irregular
Warroad River	riverine	C,B	4	30	low	regular
*Warroad-SW marshes	lacustrine	C,B	3	170	medium	regular
*South shore	lacustrine	C,B	3	200	medium	regular

a. I: impounded; S: scrub-shrub wetland (flooded forest stand)
b. C: cattails (Typha spp); B: bullrushes (Scirpus spp); H: horsetails (Equisetum); W: wild rice (Zizania spp); G: grasses (Phalaris and others)
c. 1: open water covers less than 5 percent of the wetland; 2: open water covers 5 to 95% and emergents are located in scattered patches or in the central portion; 3: central expanses of open water surrounded by bands of emergents; 4: open water covers more than 95%
d. data from the portion of the wetland with at least some open water present

Appendix 1. Location of sites surveyed in Kittson County by section.

Site	Location
Lake Stella	T163N, R51W, sections 1 and 11
Red River valley	T161N, R50W, section 34
Joe River WMA	T164N, R49W, section 34
NE Orleans 1	T164N, R48W, section 32
NE Orleans 2	T164N, R48W, section 33
NE Donaldson	T159N, R46W, sections 11, 13, 14
Skull Lake	T163N, R47W, sections 14 and 15
Lake Bronson	T161N, R46W, sections 32, 33, 34
Halma	T160N, R46W, sections 20 and 30
Karlstad	T159N, R46W, sections 26 and 35 T158N, R46W, section 3
Caribou	T163N, R45W, sections 8 and 18 T163N, R46W, sections 13, 14, 23
Juneberry Ridge	T162N, R45W, sections 15, 16, 17, 18, 24
Beeches Lake	T161N, R45W, section 8
Beaches WMA	T161N, R45W, sections 25, 26, 27
Twistal Swamp	T159N, R45W, sections 4, 8, 9, 16, 17
N. Twin Lake	T159N, R45W, sections 2 and 3 T160N, R45W, sections 34 and 35
S. Twin Lake	T159N, R45W, sections 3 and 10

Appendix 2. Location of sites surveyed in Roseau County by section.

Site	Location
Roseau River WMA	T163N, R42W, sections 7, 8, 9, 10, 11, 12, 18 T163N, R43W, sections 7, 9, 10, 11, 12, 13, 14, 17, 18 T163N, R44W, sections 1, 2, 3, 4, 5, 11, 12 T164N, R43W, sections 31 and 32
Hanks Lake	T162N, R44W, section 33
N. Juneberry cemetery	T163N, R44W, sections 28 and 33
Nereson WMA	T160N, R41W, section 28
Bednar dam	T161N, R35W, section 34
Lake of the Woods: Elm Point-NW shore	T164N, R36W, sections 28 and 29
Springsteel-Barrier Islands	T163N, R36W, sections 5 and 8
Warroad River	T163N, R36W, sections 28 and 29
Warroad-SW marshes	T163N, R36W, sections 28, 33, 34
South shore	T162N, R35W, section 6 T162N, R36W, section 1